United States Department of Agriculture,

BUREAU OF ENTOMOLOGY,

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REPORT ON THE GYPSY MOTH AND THE BROWN-TAIL MOTH, JULY, 1904.

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The renewal, in the summer of 1904, of excessive damage by the gypsy moth in the woodlands about Boston, and more or less in the residential districts, was brought to the attention of the Secretary of Agriculture primarily by Congressman Ernest W. Roberts, of Chelsea (Boston), and about the same time, also, by the secretary of the Massachusetts State board of agriculture, Mr. J. Lewis Ellsworth, in a letter addressed to the Entomologist of the Department. In compliance with the request of Mr. Roberts, the Secretary of Agriculture authorized a thorough investigation of the present status of the gypsy moth in Massachusetts, and, at the same time, of the browntail moth. Acting under instructions from the Entomologist, Dr. L. O. Howard, the writer spent some three weeks (July 1–22) in going over the infested districts about Boston, and visiting certain localities in adjoining States. The conditions found, relative to the two pests named, are summarized below.

THE GYPSY MOTH.

(Porthetria dispar Linn.)

The work of the gypsy moth committee terminated in January, 1900. The condition of the infested district about Boston at that time, as shown by the reports of the committee, and by careful examinations made by the Entomologist, Doctor Howard, and also, a little prior to the termination of the work, by the writer, was most satisfactory, from the standpoint of control, at least. In other words,

the very efficient and careful work of the agents of the committee had exterminated the moth in many of the restricted outer colonies, reduced it to inconsiderable numbers in others, and prevented defoliation in the more generally infested districts. The policy of the committee had been to effect extermination, as fast as possible, in the outer portions of the infested region, working gradually inward, but at the same time keeping up sufficient work in the central districts to prevent any material injury.

In the prosecution of this work the committee had apparently good reason to believe that extermination had been effected in a great many isolated colonies, including a considerable number of large and important ones, and it was believed by them that with sufficient funds actual extermination of the insect over the entire region of infestation would ultimately be accomplished. Whether this was possible or not, at least it had been demonstrated that the gypsy moth could be exterminated in isolated colonies, and reduced to inconsiderable numbers, or to a status approaching extermination, in areas of more general infestation.

With the cessation of the operations of the gypsy moth committee under State appropriation, the gypsy moth was left to multiply and spread at will, save for work undertaken here and there by individuals, and, in the residential districts, by the local authorities of many of the infested towns, the latter work being usually under the charge either of tree wardens or of street commissioners. In the case of the Fells reservation, also, a good deal of work has been done, especially during the last two years, under the general direction of Mr. B. de las Casas, chairman of the Metropolitan Park Commission, by Mr. Charles F. Price, in charge of the reservation. Other large areas of forest infestation, such as those surrounding the Lynn woods, and many private estates, have gone practically untreated. In the residential districts of some towns very good work has been done, as noted, by individuals or the town officials; and, while the gypsy moth has not been exterminated in these districts, it has been kept down, so that no marked defoliation of street and yard trees has resulted.

The amount expended during the last two years in such work of control, judging from careful inquiry and estimate, probably almost equals the amount expended by the State during the years of its most active operations against the gypsy moth, namely, approaching \$200,000. A single individual, Gen. S. C. Lawrence, has, for the last three years, had a large force of men working on certain gypsy moth colonies in his own and adjoining forest lands, expending each year, as he assures the writer, more than the actual value of the lands. Hundreds of individuals in each town have expended sums ranging

from \$10 to \$100 in the control of the gypsy and brown-tail moths. Nearly every town corporation has made expenditures of from a few hundred dollars to several thousand dollars for the same purpose. A number of experts, or foresters, have gone into the business of clearing the premises of individuals of gypsy and brown-tail moths, and find constant employment for considerable forces of men. In general this work is excellently done. The chief difficulty, however, is that this and other work against the moths is scattering or patchy; in other words, while some take good care of their property, others give no attention to theirs, thus leaving numerous spots for the unchecked multiplication of the pests. The result is, that while practically as much money is now being expended as was formerly spent by the State, the results are by no means comparable, from lack of general direction and uniformity.

As a consequence of the general reduction in the number of gypsy moths at the close of the work by the State, for the first two years very little notable damage was exhibited in either the woodlands or the residential districts. In September, 1902, the writer made a rather careful survey of the worst gypsy-moth regions, in company with Mr. A. H. Kirkland, former entomologist of the gypsy moth committee. At this time very little damage in the way of actual stripping of considerable areas of woodland was to be seen. A few comparatively small areas of actually-defoliated woodland were found, and the general presence of the moth was noted in the central residential districts always worst infested, but even here there was very little actual stripping. There was ample evidence, however, that the moth was on the increase, and promise of considerable damage in The comparatively little injury in the woodthe immediate future. lands in 1902 was a matter of surprise, and the suggestion was made by Mr. Kirkland that this had probably resulted from the attack of birds and other natural enemies. The greater scarcity of such natural means of control in the residential districts was suggested as the explanation for the greater infestation here noted.

The conditions found in 1902 scarcely prepared the writer for the status shown in the course of the investigations just completed. During the years 1903–4 the gypsy moth had evidently made extraordinary progress, and a condition of infestation and defoliation or stripping was found which the writer had never before seen in the gypsymoth region, and which was undoubtedly many times greater than in the worst of the earlier years of gypsy-moth damage.

In company with Mr. A. H. Kirkland, as assistant and guide, the writer made a thorough investigation of substantially all of the regions about Boston known to have been infested by the gypsy moth in 1900, and of certain new colonies which have been discovered since that time. On one occasion we were accompanied by the gypsy moth

committee of the Massachusetts State board of agriculture, General Lawrence, Professor Fernald, and others, in a tour of inspection throughout the worst districts in Medford, Malden, Melrose, and the Middlesex Fells reservation. Another day we were accompanied by Congressman Roberts and local officials from several of the worst infested towns, and also by Mr. Las Casas and Superintendent Price of the Fells reservation. In various towns we received assistance and guidance from the local tree wardens and street commissioners, and notably, in Newton, from Mr. C. W. Ross, street commissioner. On four days Mr. Kirkland and the writer were accompanied by Mr. H. L. Frost, a forester who has been doing excellent work in the control of the gypsy and brown-tail moths in Arlington and other towns. A map (fig. 1) of the infested areas was prepared and accompanies this report.

The present area infested by the gypsy moth, as shown by the careful examinations made, is substantially the same as at the close of the work by the State of Massachusetts. There has, in other words, apparently been very little extension in the area infested. Some important new colonies were discovered, but these were within the general limits of the old range of the insect. The failure of the gypsy moth to widely extend its range during the four years since 1900 is largely due to the fact, already noted, that at the close of State operations against this insect it had been reduced to such inconsiderable numbers that it was not until the present summer (1904), or perhaps to a less extent in the summer of 1903, that it had gained sufficient headway to furnish favorable conditions for distribution and the establishment of new colonies. Its excessive multiplication in the summer of 1904 will very probably lead to considerable extension of its range, and many new colonies will undoubtedly be started this year (1905).

The area of worst infestation, where general stripping of forests has resulted, extends in a broad avenue from Arlington and Winchester, or more properly from the western border of the Mystic Lakes, across Medford, including the southern edge of the Fells reservation, a portion of Melrose, and the upper half of Malden, and continues eastward through Saugus to the Saugus River. In this region the forests and the street trees are, as a rule, very generally defoliated and as bare as in winter, and altogether several thousands of acres of completely defoliated woodland occur in this strip. Spots of stripping ranging from 50 to several hundred acres, as indicated on the map by the cross-hatched areas, were found in Winchester, Lexington, Woburn, northern Melrose, and Saugus; and there were also considerable areas bounding the northern side of the Lynn woods, a single large colony in the center of the Lynn woods just above

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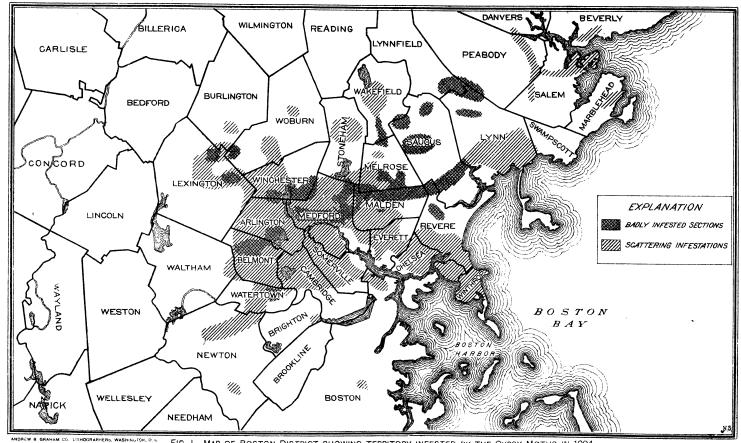


FIG. I .-- MAP OF BOSTON DISTRICT SHOWING TERRITORY INFESTED BY THE GYPSY MOTHS IN 1904.

Walden Pond, and areas in Revere, Belmont, Watertown, and western Cambridge.

Scattering infestation, that is, the occasional or fairly general occurrence of the larvæ of the gypsy moth, without, however, resulting in complete or notable stripping of the street trees and forests. was found through much of the southern half of the Fells reservation. and practically throughout the towns lying within the area of worst infestation indicated, and as far south as the Charles River. Exterior to this area of general infestation, scattering presence of the gypsy moth was found in Lexington, Winchester, and Woburn to the northwest; in Stoneham, Wakefield, Saugus, and Reading to the north; and in Peabody, Salem, Beverly, Marblehead, and Lynn to the north-To the west, Arlington, Belmont, Watertown, and Cambridge west of Harvard Square are much infested. In Newton there are perhaps some twenty-five small points of infestation, as reported by the street commissioner, Mr. Ross. Very good work in the way of control has been done in this town, and with the exception of the new colony located near Newton post-office, on the Van Etten estate, only scattering larvæ were found. The colony just referred to was discovered last year (1903), and represents a spot of bad infestation, covering a considerable area of garden, orchard, and ornamental plants. In the southern portion of Newton is located one of the worst of the outer colonies found during the course of the work of the gypsy moth committee. This colony, near the intersection of Dedham and Parker streets, originally covered several hundred acres of woodland, and was made the subject of very thorough extermination work by the committee. This work has since been followed up to some extent under the direction of Mr. Ross. A careful examination of this area shows much of it still free from the gypsy moth, but occasionally larvæ were found, showing that there is still a scattering infestation here and there which in a few years will be sufficient to repeat the damage of 1896, when the colony was first located. larvæ were found in 1902 or 1903 in the area covered by this colony, and the insect is evidently, therefore, just beginning to get a new In South Boston the gypsy moth has increased very little, and the extermination of several of the worst colonies seems to have been This is true of the Dorchester colony (Sargent street), where a considerable residential area, including also some forested hillsides which were badly infested in 1898, shows now no examples The infestation still exists in the residential district at West Cottage street, Dorchester. In the old colonies examined at Brookline no larvæ or other indications of infestation were found.

One of the most interesting features of the investigation was the demonstration that in a good many areas the careful work of the gypsy moth committee has resulted in the extermination of the insect.

This is due entirely to the work of the committee in some instances, and in others, where the work of the committee was only of one or two years' duration, the insect had evidently been reduced to such inconsiderable numbers that the natural enemies had completed the work of extermination. This is notably the case in the Georgetown colony, which had only one year's work. Other bad colonies in which the gypsy moth has not reappeared are Mount Gilead colony in Lynn woods, the colonies at Spring Pond, Peabody, Cedar Hill in Swampscott, Sargent street in South Boston, the Overlook colony in Franklin Park, and a considerable colony in the extreme western portion of the district in the town of Lincoln, the Schlesinger colony in Brookline, and a good many other less important points of infestation. Several of the areas in which the gypsy moth committee reported the moth as exterminated, and which now show slight infestation, may have become reinfested from other districts in the intervening years. The exterminated colonies enumerated, and the general control shown at the close of the work of the gypsy moth committee, indicate with sufficient emphasis that intelligent and efficient work against the gypsy moth will prevent any material damage to woodlands or residential districts.

This discussion of the gypsy moth has related entirely to the infestation about Boston. Numerous reports of infestation at remote points, and occasionally in the adjacent States, have been received by the gypsy moth committee, and by others interested in this insect. All of these reports, with the exception of one, have proven to be misidentifications, other insects having been mistaken for the gypsy moth. Most of these reports are based on the occurrence of the brown-tail moth, which has a much wider range, and which is very commonly confused with the gypsy moth in the popular mind. While the writer was conducting these investigations about Boston a very persistent and apparently well-authenticated report came to his attention of the occurrence of a well-established colony of the gypsy moth at Nashua, N. H. A visit to this town demonstrated that this, like most of the others, was an instance of confusion of the gypsy moth with the brown-tail moth, the insect at Nashua proving to be the latter species. In Massachusetts the most remote authentic point of infestation was in East Bridgewater. The writer visited this point and found that the insect had been actually introduced here, possibly maliciously, or possibly accidentally, but had been thoroughly exterminated. The infestation was limited to an isolated apple tree growing in the angle of a dwelling house, and was discovered in 1902. It proved to be a comparatively easy matter to thoroughly eradicate the pest here, and there was no evidence of work this year.

The point of infestation referred to outside of the region about Boston is in the city of Providence, R. I. This infestation has been made the subject of a special report by the Rhode Island State board of agriculture, namely, Bulletin No. 13, published September, 1901. by the late James M. Southwick, curator of the Roger Williams Park Museum. The discovery of the presence of this insect in Providence was made in July, 1901, and was investigated thoroughly at the time by Mr. Southwick, with the assistance of Prof. A. H. Kirkland, who was called down from Boston. When discovered the gypsy moth was confined to the west side of Providence, where it was established in a half dozen or more distinct colonies. The occurrence of these distinct centers of infestation, all of apparently the same age, in the heart of the city, leads to the suspicion that the insect may have been maliciously colonized at these separate points. It is impossible to believe that these distinct colonies should have been accidentally started in Providence at the same time, especially in view of the difficulties in the way of the transportation of the gypsy moth and its very slow spread about Boston, as indicated by its history during the last thirtysix years. The infestation in Providence illustrates one of the great dangers from the gypsy moth. It is readily spread by carrying egg masses, and maliciously-inclined individuals can thus easily start new colonies at any distance from the present infested area. In view of this, as emphasized by the Providence infestation, it is highly desirable that heavy penalties be provided for any malicious colonization of the gypsy moth. The important points of infestation in Providence are indicated on the accompanying map (fig. 2). The writer was assisted in locating their exact position by Messrs. Joseph D. Fitts, supervisor of parks, Providence, and C. A. Davis, present curator of the Roger Williams Park Museum. At the present time these colonies are still in existence, in spite of local work done in the way of control. Notable stripping has not occurred this year, but the larvæ and pupæ were easily discovered at the points of infestation, and there is, therefore, opportunity for much increase in the future and a repetition of the experience about Boston.

MEANS OF CONTROL.

The work of the gypsy moth committee of the State of Massachusetts developed a number of means of controlling the moth of the highest practical value and efficiency, and nothing can now be suggested in the way of improvement on these methods. The general adoption and enforcement of these will undoubtedly keep the gypsy moth in substantial control, so that no material damage to woodlands or to shade trees in residential districts need be feared. In the case of small properties, or where but a few trees are to be protected, these

means of control can be employed effectively and at reasonable cost by the individual owner. This is true, also, of the shade trees in residential districts, coming under the supervision of the street commissioners or other local officers. Where, however, large areas of woodlands are badly infested, the cost of control is beyond any reasonable expenditure by individual owners. As already indicated, such control, for a year or two at least, may much exceed in cost the actual value of the land, rendering it prohibitive so far as the individual is concerned. Furthermore, in the case of individual holdings, without any means of enforcement or corrective work, many will take little interest in the gypsy moth, and therefore do nothing to prevent its local increase, thus nullifying the work of others. In the case of large public domains, also, as, for example, the Middlesex Fells reservation, the cost of control is beyond any reasonable portion of the appropriation for the maintenance of such reservations which might be set aside for work against the gypsy moth.

If the gypsy moth is to be effectively controlled, it will be necessary to have concerted action over the entire infested area, and this will necessitate a central authority and direction. There is a wide diversity of opinion as to the best method of carrying on such work. plan employed by the gypsy moth committee consisted in expending a lump appropriation by the State in control or extermination of colonies throughout the infested district, the State appropriation covering all of the expense, none of which, therefore, was charged to the town or individual benefited. This system has some advantages. It has, however, the objection that it does not give any incentive for local control, or the protection of property by the individual. therefore seems to the writer preferable to devise some system in which the cost of control would be divided between the individual owner. the town, and the State or National Government, should national aid be granted. This idea is not altogether original, but has been given somewhat in this form by various persons who have given thought to the subject. It has been suggested that the individual whose premises were found to be infested should be charged with a portion of the cost of the extermination not to exceed the taxes on the infested property, the cost of control above this amount to be divided in accordance with some determined ratio between the town and State. advantage of this system is simply that it keeps up, in the individual and town, a wholesome interest in the control of the pest, and in many cases the individual will take some trouble to keep his premises clean, and the town, likewise, will institute care of the streets and parks, while under the old system little or no individual or local effort will be made to prevent infestation or to stamp out the gypsy moth. damage now being done by the gypsy moth is so widespread and so severe that some general system of control must be provided for at

not be attended with any possible risk, as the insects introduced feed solely on the larvæ of the gypsy moth and other allied pests, and in the absence of such food themselves perish. If national aid is to be granted to the State of Massachusetts in its warfare against this pest, such aid might very properly be in the direction of securing, importing, and installing such natural enemies. It should not be lost sight of, however, that any work of this character is purely experimental, and its value to be determined only after an interval of four or five years or more. It would probably take at least two summers in Europe to make effective importations of the parasites, and two or three more years would be necessary for their large multiplication in the gypsy-moth colonies about Boston. Furthermore, such importation might in the end prove not to be especially valuable as a means in the control of the pest. Therefore, during such experimental work the control of the pest by standard means should be kept up over the entire area infested with the exception of the particular spots of infestation, or colonies set aside for experiment with natural enemies.

THE BROWN-TAIL MOTH.

(Euproctis chrysorrhæa Linn.)

The brown-tail moth is now even better known about Boston than is the gypsy moth. The widespread information relative to the brown-tail moth arises chiefly from the fact that the hairs of the larve are distinctly poisonous and nettling, and thousands of people throughout the range of this pest have been poisoned the present summer or during past years. The hairs produce on sensitive subjects (and very few are entirely immune) a rash or nettling, with some festering, which lasts for a week or more, and is attended with more or less itching and irritation. This poisoning may result from the falling of the caterpillar on the neck and hands or clothing of the passer-by, or from the loosened hairs shed from the cast larval skin at the time of transformation to the chrysalis stage.

The loosened hairs, or the shed skin, are blown about by the winds and frequently attach to clothing hung up in yards for drying. By this means they are conveyed to the skin, resulting often in very general inflammation.

In addition to its very distinct importance as a source of discomfort to human beings, the brown-tail moth is an important tree pest, and is common in orchards in Europe. It was accidentally introduced into Somerville (Boston) and was brought to the attention of the gypsy moth committee in the spring of 1897. The investigations conducted at the time by the gypsy moth committee led to the belief that it was introduced by a floral establishment, which had been importing roses from Holland and France previous to 1890. It seems probable

that this pest was introduced on this stock, and, escaping into near-by pear orchards, had gained considerable local spread before it was noticed.

A general account of this insect has been published by the gypsy moth committee, and it has lately been made the subject of a special volume by Prof. Charles H. Fernald, of Amherst, assisted by Mr. A. H. Kirkland. The larvæ of the brown-tail moth feed by preference on the foliage of fruit trees, especially pear and apple. The chief damage, therefore, in this direction has been in orchards or on fruit trees grown in yards. It has, however, a wide range of food plants, and will subsist on many forest trees, although notable damage or forest stripping has not been characteristic of it. The habits of the insect render it much more readily controlled than the gypsy moth. The winter is passed in the half-grown larval stage in small but conspicuous webs attached to the terminal twigs. The chief means of control is the collection in the winter of these webs and burning them, and, if this be done with any degree of thoroughness, trouble from the brown-tail moth may be very largely overcome.

Unlike the gypsy moth, the female of the brown-tail moth is a strong flyer, and hence the distribution of this insect has been very rapid. It has now overrun southern New Hampshire and south-western Maine, as well as the northeastern counties of Massachusetts, and will undoubtedly extend its range widely in North America in a comparatively few years. There is no means of preventing such ultimate spread, but prompt effort at control will much retard its progress. During July, 1904, while the writer was conducting his investigations about Boston, the moths of this insect were emerging in great numbers, and were attracted in their nocturnal flight to electric and other lights. It was no uncommon sight to see electric-light poles whitened by hundreds of these snowy white moths, and thousands were killed about the electric lights. Some benefit could undoubtedly be obtained by a trap connected to electric lights which would destroy more of the moths than the lights do themselves.

During the time when the flight of these moths was at its height enormous numbers of them were brought by favoring winds into the heart of Boston, causing considerable interest and excitement in Newspaper Row, the swarm having centered there, and resulted in a number of accounts, illustrated by photographs locally taken, in the daily papers of the following morning.

The distribution of the brown-tail moth, as already indicated, has been in a northerly direction. South of Boston it is known to occur in the double tier of towns bordering Massachusetts Bay as far as Scituate. The entire northeastern portion of Massachusetts was invaded as early as 1899. By 1902 the invasion had extended westward to Brockton, Hudson, and Stow, in Massachusetts. The moth

was reported at Kittery, Me., as early as 1899, by the late Prof. F. L. Harvey. It has also been reported by Prof. James Fletcher, the Canadian Government entomologist, as occurring at St. Johns, New Brunswick, where it was supposed to have been transported by steamers plying between Boston and St. Johns. In 1902 the moth was abundant in all the towns along the eastern division of the Boston and Maine Railroad, as far as Portsmouth, N. H. During the last two years, and especially the summer of 1904, the moth must have extended its ravages considerably in both New Hampshire and Maine. Its occurrence at Nashua, N. H., has been referred to in the discussion of the gypsy moth. The counties of Rockingham, Hillsboro, and Stafford, N. H., are known to be pretty generally infested.

Strong gales of wind at night during the flying season must extend the distribution of this moth many miles. This was illustrated by the results of the high gales prevailing in New England July 12–14, 1897, which were largely responsible for the spread of the moth over much of the area now infested. The ability of this moth to extend its range over much of northeastern United States in the near future is abundantly shown by this instance and its history up to the present time.

The control of this moth will need, perhaps, less of town and State aid than the gypsy moth, but some provision should be made to enforce the removal of the caterpillars' webs in winter, and the authorities charged with the work against the gypsy moth should be empowered to enforce corrective work against the brown-tail moth also. In the introduction of parasites for the gypsy moth the brown-tail moth should also be considered. These two insects have many common natural enemies, but the special enemies of each should be introduced. For detailed information on the history of the brown-tail moth and on means of control, reference is made to the publications cited above.

Approved:

James Wilson, Secretary of Agriculture.

Washington, D. C., *March* 21, 1905.